

CAN-CBM-BRIDGE/2

Intelligent CAN-Bridge



Hardware Manual

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Changes in the chapters

The changes in the manual listed below affect changes in the hardware as well as changes in the description of facts only.

Chapter	Changes versus previous version
3.2	Notes about mask command added.
4.1	Description of adapter cable ‘combicon-DSUB9’ added.

Technical details are subject to change without further notice.

N O T E

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1. Overview

1.1 Module Description

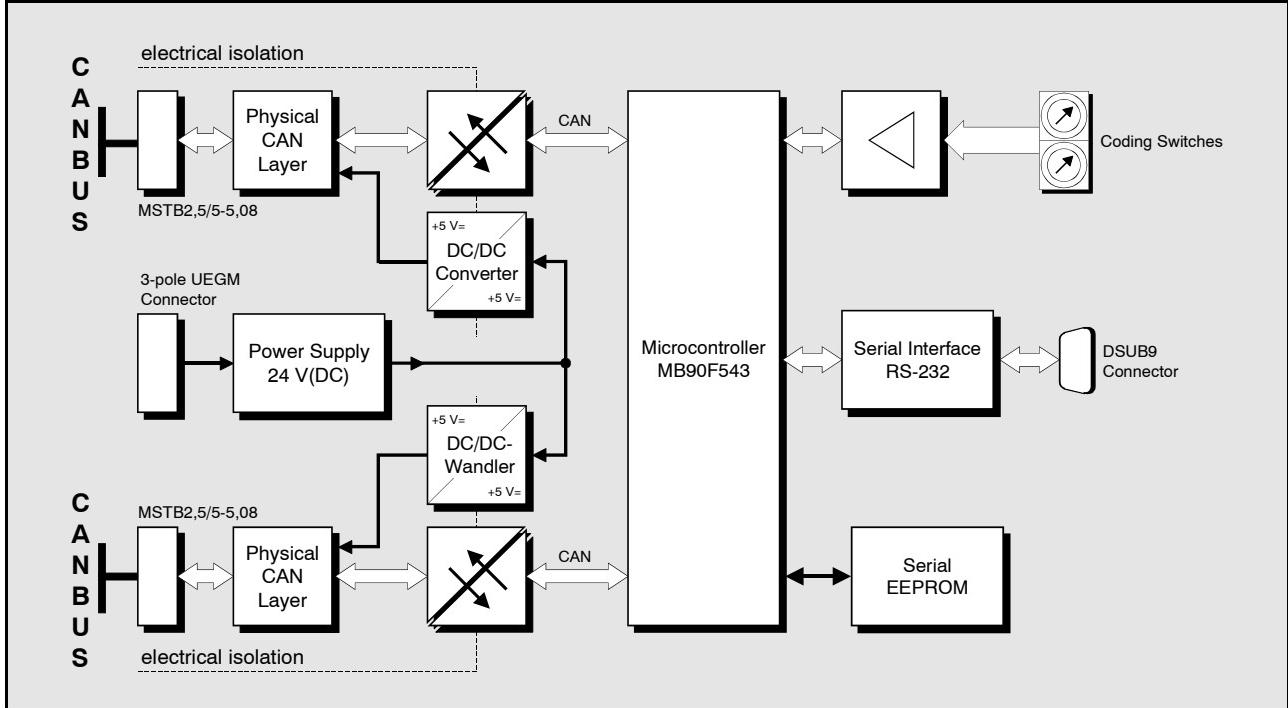


Fig. 1.1: Block circuit diagram of CAN-CBM-BRIDGE/2 module

The module **CAN-CBM-BRIDGE** can connect two independent CAN nets. The nets can be operated with different bit rates.

The module works with a MB90F453 microcontroller which buffers CAN data into a local SRAM. The firmware is contained in the flash. Parameters are stored in a serial EEPROM.

The ISO 11898-compliant CAN interfaces allow a maximum data transfer rate of 1 Mbit/s each. The CAN interfaces are electrically insulated by optical couplers and DC/DC converters. They are connected via 5-pin screw/plug connectors in Combicon design.

For matters of service and development the module features a serial interface. RS-232 is used as physical interface. It is connected via a DSUB9 connector.



Overview

1.2 Front View with Connectors and Coding Switches

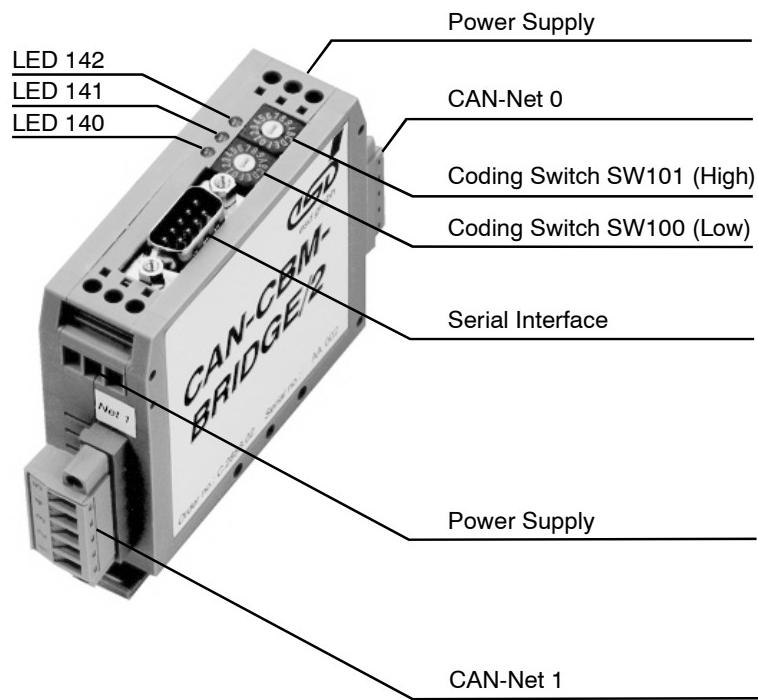


Fig. 1.2.1: Position of connectors and control devices



1.3 Summary of Technical Data

1.3.1 General Technical Data

Power supply	permitted voltage range 12 V _{DC} ... 32 V _{DC} Nominal voltage 24 V _{DC} , current (at 24 V, 20 °C): typ. 100 mA
Connectors	X100 (DSUB9, male) - serial interface X300 (2x3-pin screw connector UEGM) - 24 V power supply X200 (Combicon design, 5-pin MSTB2.5/5-5.08) - CAN net 0 X250 (Combicon design, 5-pin MSTB2.5/5-5.08) - CAN net 1
Temperature range	0...50 °C ambient temperature, (-20 °C ... +70 °C on request)
Humidity	max. 90%, non-condensing
Case dimensions (W x H x D)	Width: 20 mm, height: 85 mm, depth: 83 mm (including hatrail mount and jutted out connector DSUB9, without CAN connector)
Weight	ca. 120 g

Table 1.3.1: General data of the CAN-CBM modules

1.3.2 Microcontroller Unit

Microcontroller	MB90F543
Memory	SRAM: intern in MB90F543, 6 kbyte Flash-EPROM: intern in MB90F543, 128 kbyte EEPROM: serial SPI-EEPROM

Table 1.3.2: Microcontroller units



Overview

1.3.3 CAN Interface

Number of CAN interfaces	2x CAN
CAN controller	MB90F543, CAN 2.0A/B, 11-bit and 29-bit CAN identifier
Status display	yellow LEDs
Electrical insulation of CAN interfaces from other units	via optocouplers and DC/DC converters reference voltages 300 V _{DC} /250 V _{AC}
Physical layer CAN	physical layer in accordance with ISO 11898, transfer rate programmable from 10 Kbit/s to 1 Mbit/s

Table 1.3.3: Data of CAN interface

1.3.4 Serial Interface

Controller	MB90F543
Interface	RS-232, only the signals RxD, TxD and GND are supported
Connection	9-pin DSUB connector

Table 1.3.4: Data of serial interface



1.3.5 Software

Configuration	via terminal at serial interface
Update	update option via serial interface
CAN bit rate	adjustable in 14 steps or bit-timing register of the controller can be programmed directly
CAN identifier	11-bit and 29-bit-CAN identifiers (also in combination)
Number of CAN-identifier areas which can be masked to link the nets	2 masks per CAN net
Number of CAN-identifier links which can be set individually	13 in direction from net 0 to net 1 and 13 in direction from net 1 to net 0

Table 1.3.5: Performance features of the software



Order Information

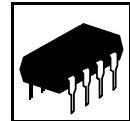
1.4 Order Information

Type	Features	Order No.
CAN-CBM-BRIDGE/2	CAN-Bridge with 11-bit and 29-bit identifier	C.2853.02
CAN-CBM-BRIDGE/2-ME	User manual in English ^{1*)} (this manual)	C.2853.21
CAN-CBM-BRIDGE/2-ENG	Engineering manual in English ^{2*)} , Contents: schematic diagrams, PCB top overlay drawing, data sheets of significant components	C.2853.25

^{1*)}... If module and manual are ordered together, the manual is free of charge.

^{2*)}... This manual is liable for costs, please contact our support.

Table 1.5.1: Order information



2. Description of Units

2.1 CAN Unit Interface Circuit

2.1.1 Interface circuit

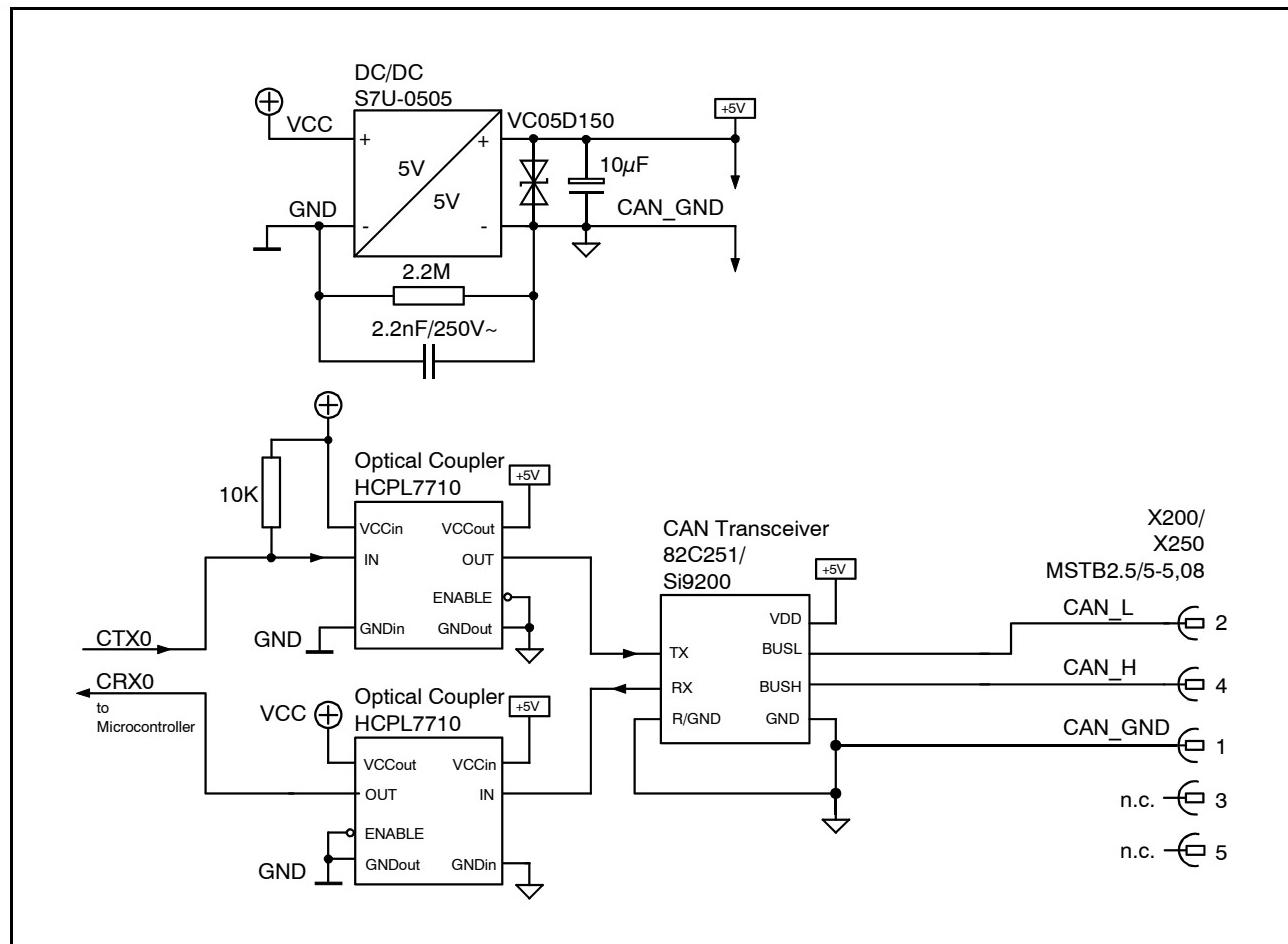
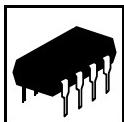


Fig. 2.1.1: CAN interface circuit



Description of Units

2.2 Serial Interface

2.2.1 Default Setting of CAN-CBM-Bridge/2 Module

Bitrate: 9600 Baud
Data bits: 8
Parity: no
Stop bit: 1
Handshake: XON/XOFF

2.2.2 Configuration

The serial interface is controlled by microcontroller MB90F543. The bitrate is 96 000 Baud. Set the user's terminal / PC to this value. The bitrate can not be changed at the CAN-CBM-Bridge/2 module.

2.2.3 Connecting the Serial Interfaces

Below, the wiring of the serial interface is shown. The figure is used to explain the short terms of the signals as used in the chapter Connector Assignments. The signal description is given exemplary for the connection of the CAN-CBM-BRIDGE/2 to a PC.

Hint: For the connection of the CAN-CBM-Bridge/2 module to the RS-232 interface of the PCs a nullmodem is necessary (if not already considered by the configuration of the serial lines).

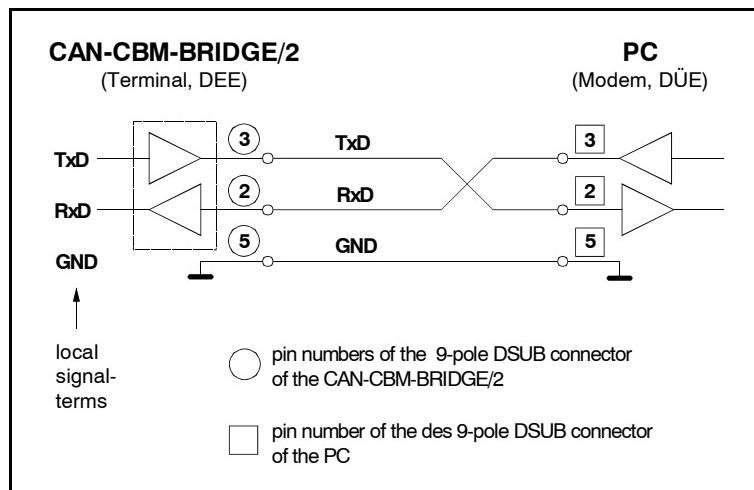
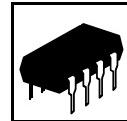


Fig.2.2: Connection diagram for RS-232 operation



2.3 Function of Coding Switches

The configuration of the module can be changed via the coding switches.

Standard operation: ‘Individual Configuration’:

Usually customers configure the CAN-CBM-BRIDGE/2 themselves (see chapter ‘Configuration of the CAN-CBM-BRIDGE/2’, from page 13). For this both coding switches have to be set to ‘0’ when the module is switched on (power on). During configuration and operation the coding switches are not evaluated, therefore it is recommendable to leave them set to ‘0’ at all times.

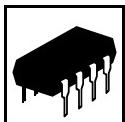
Attention: When switching on the power both coding switches must be set to ‘0’!
Settings unequal ‘0’ are only permissible to select customized configurations.

Special case ‘Customized Configuration’:

By means of the coding switches programmed configurations can be selected. These customized configurations are selected via coding switch positions unequal ‘0’. They can, for example, contain set assignments of CAN-identifiers of both networks. Should you require a lot of CAN-CBM-BRIDGE/2 modules with the same configuration for an application, feel free to contact our support team. We would be pleased to make you an offer for an individual solution.

Coding switch	Function	Default setting at delivery
SW101 (High)	Setting of customized configurations	‘0’
SW100 (Low)	Setting of customized configurations	‘0’

Table 2.3.1: Function of coding switches



Description of Units

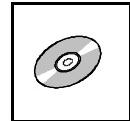
2.4 LED Display

In fault-free status the green as well as both yellow LEDs shine continuously. In case of an error in one of the two CAN-networks the according LED starts flashing.

The upper LED 142 (see front view on page 4) shows errors in CAN-network 0 and the middle LED 141 errors in CAN-network 1.

LED	Colour	Function	Status	Meaning
LED 142	yellow	status CAN 0 status CAN 1	off	no power supply or CPU is not working
LED 141			permanently shining flashing	CAN-status OK CAN-error (such as bus off)
LED 140	green	power	off	power supply ‘off’
			shining	power supply ‘on’

Table 2.4.1: LED status



3. Configuration of the CAN-CBM-Bridge/2

This Chapter describes the procedure for the configuration of the CAN-CBM-Bridge/2 which can easily be done e.g. by means of the program ‘Hyperterminal’ of Windows.

3.1 Serial Interface and Coding Switches

The serial interface of the PC has to be configured with the values which are described in chapter *Default Setting of CAN-CBM-Modules*, (page 10).

Attention: At the module CAN-CBM-Bridge/2 both coding switches has to be set to ‘0’ at power on!
Settings unequal ‘0’ are only permitted for ‘Customized Configuration’ (see page 11).

3.1.1 Commands

After the power supply has been switched on the CAN-CBM-module wakes up in the hyperterminal and puts out a message.

Now you can enter the commands directly and acknowledge with >Enter<.

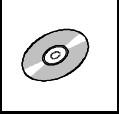
COMMANDS:

R Command **R** shows the current configuration of the module. In the example below the module is still in default setting. The following message will be displayed:

input: **R** >Enter<

output: B0 : 6
 B1 : 6

Both CAN nets have got a default bit rate of 125 kbit/s, this corresponds to a *HexIndex* of 6 (see Table 3.2.1), when leaving the manufacturer.



Configuration

Bn : HexIndex By means of the command **Bn :** you can configure the desired bit rate of the CAN net with net number **n**, with:

n= 0 for net 0

n= 1 for net 1

If values between 0 hex to F hex are specified for *HexIndex*, the bit rate is configured according to the following table:

<i>HexIndex</i>	Bit rate [kbit/s]	<i>HexIndex</i>	Bit rate [kbit/s]
0	1000	8	66.6
1	666.6	9	50
2	500	A	33.3
3	333.3	B	20
4	250	C	12.5
5	166	D	10
6	125	E	reserved
7	100	F	reserved

Table 3.2.1: Index of bit rate

In the following example the bit rate of net 1 ($n=1$) is to be configured to 10 kbit/s. From Table 3.2.1 you get the *HexIndex* = D. Your input therefore is as follows:

input: **B1 : D** >Enter<

Bn : 8000yyzz Alternatively you can configure the bit-timing register of the MB90F543 component used, directly. In this case the register value for the bit-timing registers BTR0 and BTR1 is specified directly.

Here is: **n:** 0 ,1... net number

yy: value for BTR0

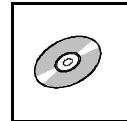
zz: value for BTR1

Please refer to the manuals of the controller MB90F543 for the correct way to determine the bit timing and the bit rate from the register values.

The manual can e.g. be downloaded from the Fujitsu-Homepage:

<http://www.fme.gsdc.de/gsdc.htm?products/mb90495g.htm>

Choose the 'MB90F540/545G Series Hardware Manual VX-xx'.

**I0:ID net 0 I1:ID net 1**

This command assigns an identifier of CAN net **1** to an identifier of CAN net **0**. The identifier *ID net 0*, which is received by CAN net **0** is assigned to identifier *ID net 1* of CAN net **1**.

Note:

If you want to configure 29-bit CAN identifier (value range bit 28...bit 0), bit 29 has to be configured (20000000 hex corresponding to CANopen!).

In the example below the 29-bit identifier 3456789 hex of net **0** is mapped to the 11-bit identifier 543 hex of net **1**.

Input: I0:23456789 I1:543 >Enter<
--

In the following example the 11-bit identifier *ID net 0* = 200 hex is mapped to the 11-bit identifier *ID net 1* = 300 hex.

Input: I0:200 I1:300 >Enter<

I1:ID Net 1 I0:ID Net 0

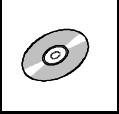
This command assigns an identifier of CAN net **0** to an identifier of CAN net **1**. The identifier *ID net 1*, which was received by CAN net **1** is transmitted to identifier *ID net 0* of CAN net **0**.

In the following example the 29-bit identifier *ID net 1* = 4567893 hex is to be transmitted to the identifier *ID net 0* = 205 hex.

Input: I1:24567893 I0:205 >Enter<
--

If you configure an identifier which is not between 0 hex and 7FF hex or within the 29-bit range, the assignment is not accepted.

At the moment a total of 13 ID assignments are possible for both directions.



Configuration

Mm : n : zzzzzzzzzzzzzzzzzzzzzzzzzzzzzzz

This command defines masks for 29-bit identifiers.

This way all identifiers or particular areas of identifiers can be assigned.

Here is:

m : 0,1... net in which the identifiers are to be received

n : 0,1... net in which the filtered CAN frames are to be transmitted

z . . . z : 0, 1, x.. mask

0: the according bit has to be logically 0

1: the according bit has to be logically 1

x: the status of the according bit does not matter

Attention: Please note that the bits are numbered from right to left.
The first bit from the left is therefore bit 30!

The mask must always have the full length of 30 bits (29 bits + 30th bit to distinguish between 11-bit and 29-bit identifiers).

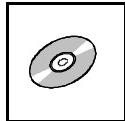
The first bit is the distinction bit, the following bit is the MSB of the CAN identifier, etc.

Bit 30	Meaning
0	11-bit identifier
1	29-bit identifier
x	11- and 29-bit identifier

In the following example only the odd identifiers between 0 hex and FF hex are let through from net 0 to net 1:

Input: **MO : 1 : 000000000000000000000000xxxxxx1**
>Enter<

If more than one mask has been defined for one direction, one identifier has to pass all masks (AND links) in order to be mapped in the other net. At the moment 2 masks are possible for each direction.



The current configuration of the CAN-CBM-Bridge module from the previous examples can be displayed by means of command **R**.

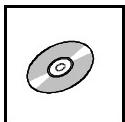
Input:	R >Enter<
Output:	B0:6 I0:200 I1:300 I0:23456789 I1:543 M0:1:000000000000000000000000xxxxxx1 B1:D I1:24567893 I0:205

E After the configuration has been successfully completed, the configured data is stored in the configuration memory by means of command **E**. Only after the data has been stored the changes become effective.
The CAN-CBM-Bridge module is now in RUN status and meets the desired bridge function.

Input:	E >Enter<
--------	------------------

C You can delete a configuration again by means of the command **C**. The command deletes **all** identifier assignments and resets the CAN bit rates to the default value of *HexIndex* 6, that is a bit rate of 125 kbit/s. The configuration memory is also deleted.

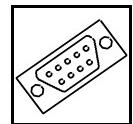
Input:	C >Enter<
--------	------------------



Configuration

3.1.2 Change Existing Configurations

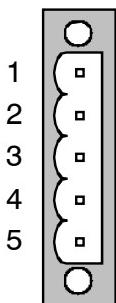
It is not possible to modify single parameters of an existing configuration. You have to call the command **C** (see page 17) to clear all parameters. After that you have to configure the CAN-CBM-Bridge/2 again with the correct parameters. Do not forget to call the command **E** to store the configured data to the configuration memory.



4. Connector Assignments

4.1 CAN Bus (X200/X250, Combicon-Style)

Pin Position:

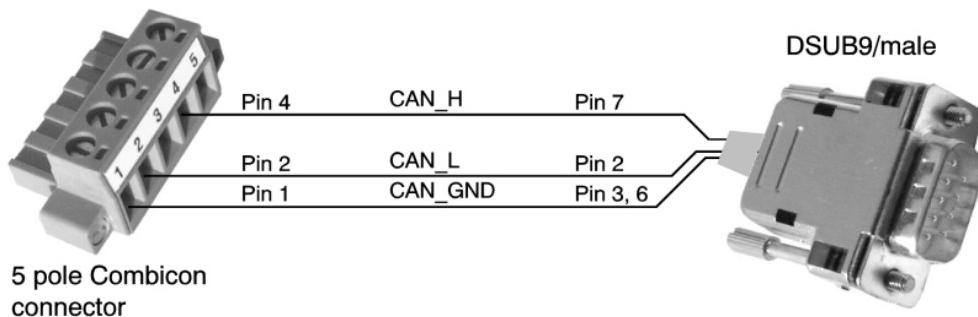


Pin Assignment:

Pin	Signal
1	CAN_GNDx
2	CAN_Lx
3	shield
4	CAN_Hx
5	n.c.

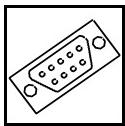
Signal description:

- x... CAN channel number (x = 1, 2)
- CAN_Lx, CAN_Hx... CAN signal lines
- CAN_GND ... reference potential of the local CAN physical layer
- Shield... shielding
(The shield lines of both CAN channels are linked directly)



The 9-pin DSUB connector is assigned in accordance with CiA DS 102.

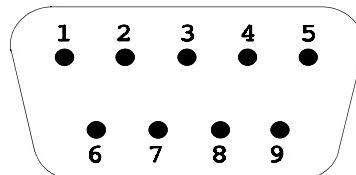
Fig 4.1: Adapter cable 5-pole Combicon to 9-pole DSUB



Connector Assignments

4.2 RS-232 Interface (X100, 9-pin DSUB male)

Pin Position:

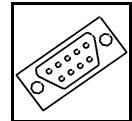


Pin Assignment:

Signal	Pin		Signal
n.c.	6	1	n.c.
		2	RxD (input)
n.c.	7	3	TxD (output)
		4	n.c.
n.c.	8	5	GND

9-pin DSUB male

n.c. ... not connected



4.3 Access line for the serial Interface

Below the access line of the serial interface (RS-232) of the CAN-CBM-BRIDGE/2 to a PC is shown.

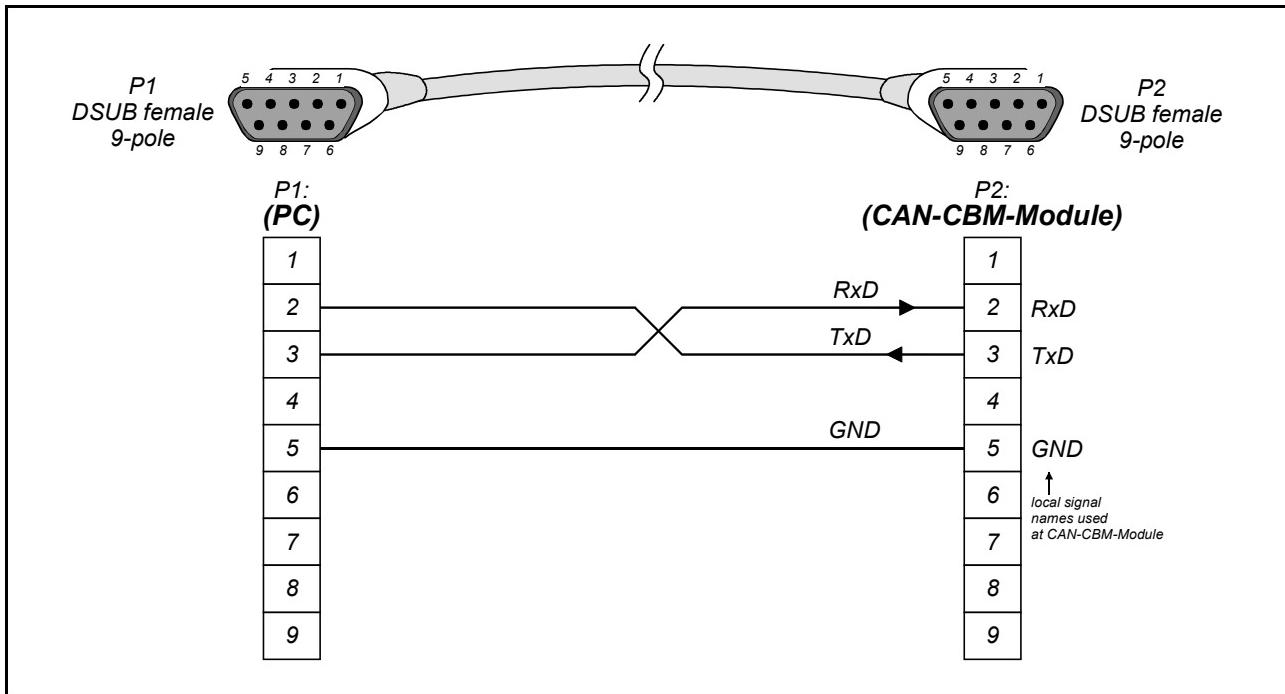
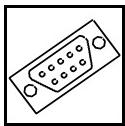


Fig. 4.3.1: Assignment of Access line



Connector Assignments

4.4 Power Supply (X101, UEGM)

The power is supplied by means of the UEGM screw connectors integrated in the case. They are suitable for lines with a cross section of up to 2.5 mm².

The connector assignment is the same on both sides of the case. They can be used alternatively. The middle contact has been designed for +24 V and the two outer contacts for GND.

The permitted voltage range is +12 V_{DC} ... +32 V_{DC}

Note: It is **not** permissible to ‚feed through‘ the 24 V power supply, i.e. to use one side as 24 V input and the other side as 24 V output in order to supply further devices!

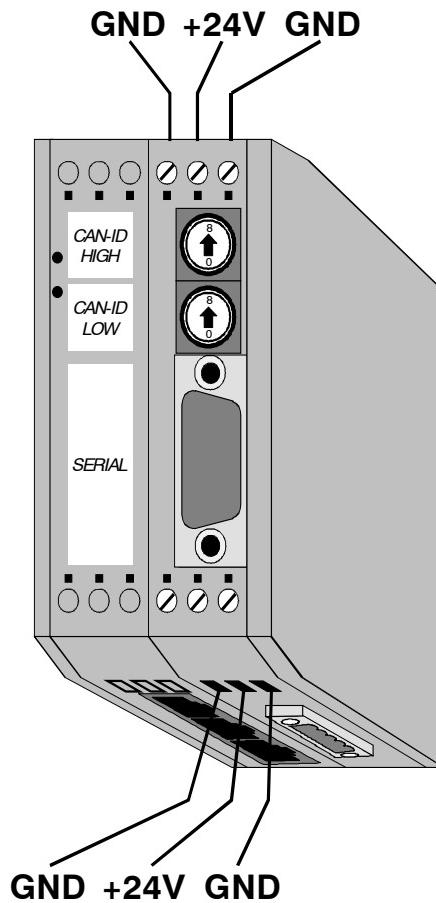
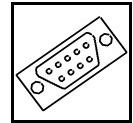
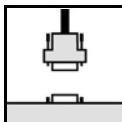


Fig 3.1.1: Power supply

Connector Assignments



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Wiring

5. Correctly Wiring Electrically Isolated CAN Networks

Generally all instructions applying for wiring regarding an electromagnetic compatible installation, wiring, cross sections of wires, material to be used, minimum distances, lightning protection, etc. have to be followed.

The following **general rules** for the CAN wiring must be followed:

1.	A CAN net must not branch (exception: short dead-end feeders) and has to be terminated by the wave impedance of the wire (generally $120 \Omega \pm 10\%$) at both ends (between the signals CAN_L and CAN_H and not at GND)!
2.	A CAN data wire requires two twisted wires and a wire to conduct the reference potential (CAN_GND)! For this the shield of the wire should be used!
3.	The reference potential CAN_GND has to be connected to the earth potential (PE) at one point. Exactly one connection to earth has to be established!
4.	The bit rate has to be adapted to the wire length.
5.	Dead-end feeders have to kept as short as possible ($l < 0.3 \text{ m}$)!
6.	When using double shielded wires the external shield has to be connected to the earth potential (PE) at one point. There must be not more than one connection to earth.
7.	A suitable type of wire (wave impedance ca. $120 \Omega \pm 10\%$) has to be used and the voltage loss in the wire has to be considered!
8.	CAN wires should not be laid directly next to disturbing sources. If this cannot be avoided, double shielded wires are preferable.

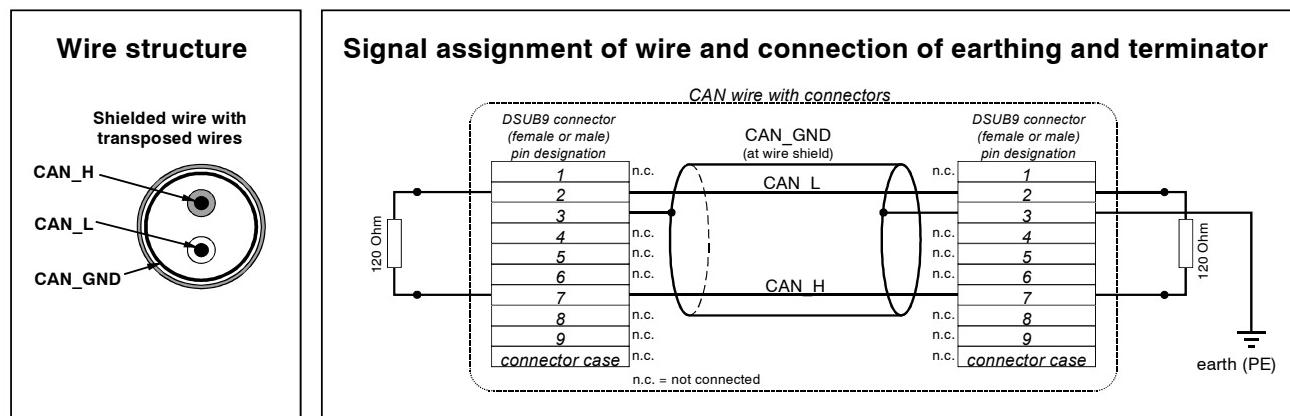
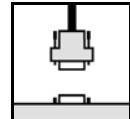


Figure: Structure and connection of wire

Wiring



Cabling

- for devices which have only one CAN connector per net use T-connector and dead-end feeder (shorter than 0.3 m) (available as accessory)

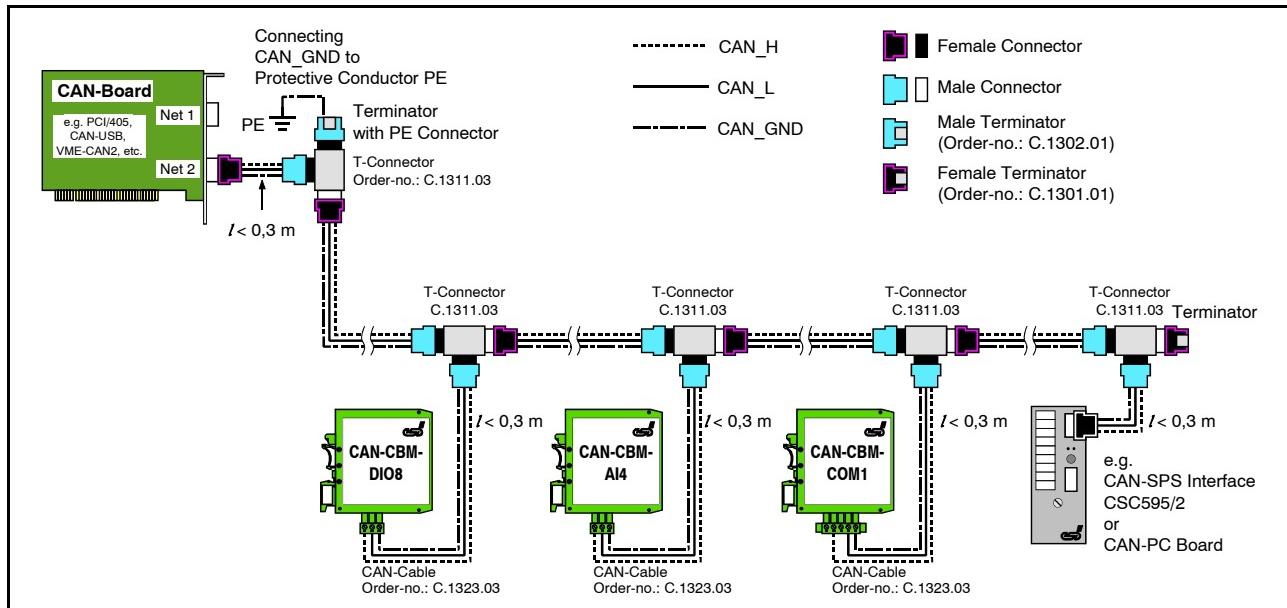


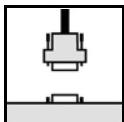
Figure: Example for correct wiring (when using single shielded wires)

Terminal Resistance

- use **external** terminator, because this CAN later be found again more easily!
- 9-pin DSUB-terminator with male and female contacts and earth terminal are available as accessories

Earthing

- CAN_GND has to be conducted in the CAN wire, because the individual esd modules are electrically isolated from each other!
- CAN_GND has to be connected to the earth potential (PE) at **exactly one** point in the net!
- each CAN user without electrically isolated interface works as an earthing, therefore: do not connect more than one user without potential separation!
- Earthing CAN e.g. be made at a connector



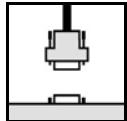
Wiring

Wire Length

- Optical couplers are delaying the CAN signals. By using fast optical couplers and testing each board at 1 Mbit/s, however, esd CAN guarantee a reachable length of 37 m at 1 Mbit/s for most esd CAN modules within a closed net without impedance disturbances like e.g. longer dead-end feeders. (Exception: CAN-CBM-DIO8, -AI4 and AO4 (these modules work only up to 10 m with 1 Mbit/s))

Bit rate [Kbit/s]	Typical values of reachable wire length with esd interface l_{\max} [m]	CiA recommendations (07/95) for reachable wire lengths l_{\min} [m]
1000	37	25
800	59	50
666.6	80	-
500	130	100
333.3	180	-
250	270	250
166	420	-
125	570	500
100	710	650
66.6	1000	-
50	1400	1000
33.3	2000	-
20	3600	2500
12.5	5400	-
10	7300	5000

Table: Reachable wire lengths depending on the bit rate when using esd-CAN interfaces

Wiring

Examples for CAN Wires

Manufacturer	Type of wire
U.I. LAPP GmbH Schulze-Delitzsch-Straße 25 70565 Stuttgart Germany www.lappkabel.de	e.g. UNITRONIC ®-BUS CAN UL/CSA (UL/CSA approved) UNITRONIC ®-BUS-FD P CAN UL/CSA (UL/CSA approved)
ConCab GmbH Äußerer Eichwald 74535 Mainhardt Germany www.concab.de	e.g. BUS-PVC-C (1 x 2 x 0,22 mm ²) Order No.: 93 022 016 (UL appr.) BUS-Schleppflex-PUR-C (1 x 2 x 0,25 mm ²) Order No.: 94 025 016 (UL appr.)
SAB Bröckskes GmbH&Co. KG Grefrather Straße 204-212b 41749 Viersen Germany www.sab-brockskes.de	e.g. SABIX® CB 620 (1 x 2 x 0,25 mm ²) Order No.: 56202251 CB 627 (1 x 2 x 0,25 mm ²) Order No.: 06272251 (UL appr.)

Note: Completely configured CAN wires can be ordered from **esd**.

EG-KONFORMITÄTSERKLÄRUNG

DECLARATION OF CONFORMITY



Adresse
Address

esd electronic system design gmbh
Vahrenwalder Str. 207
30165 Hannover
Germany

esd erklärt, daß das Produkt
esd declares, that the product

CAN-CBM-Bridge/2

Typ, Modell, Artikel-Nr.
Type, Model, Article No.

C.2853.02

die Anforderungen der Normen
fullfills the requirements of the standards

DIN EN 50121-4 (03.2000)
DIN EN 50081-1 (03.1993)
DIN EN 50081-2 (03.1994)
DIN EN 61000-6-2 (03.2000)

gemäß folgendem Prüfbericht erfüllt.
according to test certificate.

2145.1005.01

Das Produkt entspricht damit den EG-Richtlinien
Therefore the product corresponds to the EU-Directives

89/336/EWG (23.05.1989)
92/31/EWG (28.04.1992)

Diese Erklärung gilt für alle Exemplare, die das CE-Zeichen tragen und verliert ihre Gültigkeit,
wenn Veränderungen am Produkt vorgenommen werden.
*This declaration is valid for all units with the CE label on it and it lose its validity if a modification
is done on the product.*

Name / Name
Funktion / Title
Datum / Date

Dr. Ing. Werner Schulze
Geschäftsführer
Hannover, den 04.02.2002

Rechtsgültige Unterschrift / *authorized Signature*

A handwritten signature in black ink, appearing to read 'Werner Schulze', is placed over a dotted line.